NIST Interoperability Cost Studies

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Presented by

Dr. Michael P. Gallaher
Research Triangle Institute

Presentation Overview

- Automotive Interoperability Study
  - Project Objectives and Scope
  - Methodology
  - Impact Estimates
- STEP Economic Impact Study
  - Project Objectives and Scope
  - Methodology
  - Upcoming data collection activities

Interoperability Cost Analysis of the U.S. Automotive Supply Chain

- Conducted by Research Triangle Institute on behalf of NIST
- Completed March1999
- Report can be downloaded at: http://www.rti.org/publications/cer/7007-3-auto.pdf
- Acknowledgments:
  - Dr. Sheila Martin and Smita Brunnermeier (RTI)
  - Dr. Thomas A. Phelps (ERIM)
  - Dr. Gregory Tassey, Dr. Simon Frechette, and Dr. James Fowler (NIST)

Background

- Interoperability is the ability to communicate product data across different production activities.
- Interoperability is essential to the productivity and competitiveness of many industries because efficient design and manufacturing require the coordination of many different participants and processes that rely on a digital representation of the product.

Project Objectives

- The objective of this study was to assess the costs of imperfect interoperability to the U.S. automotive supply chain and to describe the sources of these costs.
- By understanding the sources and magnitude of inefficiencies caused by interoperability problems, NIST can better determine the potential impact of its programs and focus them to maximize program effectiveness.

Project Scope and Findings

- Study focused on the Automotive Supply Chain
- This study estimates that imperfect interoperability imposes at least $1 billion per year on the members of the U.S. automotive supply chain.
- By far, the greatest component of these costs is the resources devoted to repairing or reentering data files that are not usable for downstream applications.
- We consider this estimate to be conservative because the study could not quantify all sources of interoperability costs.

Interoperability Cost Drives

Cost Driver	Description
Number of customers/suppliers	Z Additional customers and/or suppliers may increase the required number of computer-aided design (CAD) systems or translators.
Position in supply chain	Z Original equipment manufacturers (OEMs) require that their suppliers provide PDE data in the native format of the OEMs' choosing; subtier suppliers are often too small to maintain multiple platforms or translators. Therefore, first-tier suppliers often incur the costs of the interoperability problem (but may pass these costs on to the OEMs).
Design responsibility	Z Does the supplier provide significant design input, or do they simply manufacture the part to the customer's design specifications? Joint design responsibility requires the greatest level of data exchange between the supplier and the customer.
Design reuse	Z Is the component design new or is it a modification of an existing design? New designs require a greater level of data exchange.
Design complexity	Z The more complex the design, the greater the probability that errors will occur during file transfer. File size is often used as a proxy for design complexity.
Tolerance	Z The smaller the permissible margin of error or required goodness of fit, the more imperative it is to repeat transfer attempts or manually reenter data so that the file is error free.
Number of prototype iterations	Z Increasing the number of prototype iterations increases the cost of PDE.
Life-cycle impact	Z Late changes in design or error detection increase costs.
Degree of concurrent design and engineering	Z The greater the number of systems that are being designed and manufactured concurrently, the greater the probability that delays in developing a given component/system will delay other components/systems.
Engineer training and use of design standards	Z When engineers are trained and make use of standard practices for the development of CAD data, the data are more usable by downstream functions.

Impact Taxonomy (I)

- To estimate interoperability costs we developed two kinds of impact metrics:
  - *Technical impacts* describe the effects of imperfect interoperability on the accuracy and usability of exchanged product data and the resources required (including time) for data exchange and product development.
  - *Economic impacts* describe how technical impacts translate into changes in cost and economic activity. These measures can be either quantitative or qualitative
- The components of Interoperability costs are grouped into
  - avoidance costs
  - mitigation costs, and
  - delay costs

Impact Taxonomy (II)

- Avoidance costs include
  - the cost of purchasing, maintaining, and training for redundant CAD/computer-aided manufacturing (CAM) systems for the purpose of native format translation;
  - the cost of purchasing, maintaining, and training for point-to-point translation software;
  - the cost of purchasing, maintaining, and training for neutral format translation software;
  - outsourcing costs incurred when outside companies are hired to provide data exchange services;
  - investments in in-house programs aimed at addressing interoperability issues, such as implementing STEP or training engineers in proper product model data creation; and
  - the cost of participating in industry consortia activities aimed at improving interoperability throughout the industry.

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Impact Taxonomy (III)

- Mitigating costs include
  - the cost of reworking scrapped models, designs, prototypes, parts, dies, etc., that were incorrect due to interoperability problems; and
  - the cost of manually reentering data when other methods of data exchange are unavailable or unsatisfactory.
- Delay costs include
  - profits lost due to decline in market share caused by delays;
  - profits lost due to delay of revenues (discounts the value of future profits); and

Data Collection

- Interviews were conducted with all three automotive OEMs, a purposive sample of large suppliers and tooling suppliers.
- Questionnaires were used to support a combination of telephone surveys and written surveys.
- Because a small purposive sample of the industry was used – results cannot be considered to be statistically representative of entire effected population.
- Nevertheless, we developed methods for extrapolation based on sales information available from secondary data sources to estimate industry impacts.

Impact Estimates

Summary of Annual Interoperability Costs for the Automotive Industry

	Costs by Industry Segment ($thousands)				
Source of Cost	**OEMs**	**Suppliers**	**Tooling**	**Total**	**Percent of Total**
Avoidance costs	2,302	35,656	14,841	52,799	5
Mitigating costs	247,773	204,094	455,778	907,645	86
Delay costs				90,000[a]	9
Total costs				1,050,444	100

[a]We could not determine the distribution of delay costs or total costs.

Impact Estimates

Sources of Annual Avoidance Costs for the Automotive Industry

	Costs by Industry Segment ($thousands)			
Source of Cost	**OEMs**	**Suppliers**	**Tooling**	**Total**
Redundant software				
Licenses	0	8,918	3,107	12,025
Maintenance	0	4,524	2,821	7,345
Training	0	3,278	8,914	12,192
Redundant software costs (subtotal)	0	16,720	14,842	31,562
Data translation outsourcing	2,042	15,594	0	17,636
Investments in interoperability solutions	260	3,341	0	3,601
Total avoidance costs	2,302	35,655	14,842	52,799

Mitigation Costs

- Account for 86 percent of costs
  - One OEM mentioned that downstream engineering departments spend as much as 50 percent of their time dealing with poor translations or poor quality CAD/CAM data files
  - One OEM noted that, on the average, rework requires an average of 4.9 hours per data exchange
  - Tooling suppliers reported that they consistently must make significant changes to the product data to make it useful for their purposes.

Market Barriers in the Development of Interoperability Solutions

- Nonappropriability of benefits
- High Technical and market risk
- Need for unbiased expertise

Economic Impact Assessment of International Standard for the Exchange of Product Model Data (STEP)

- Being Conducted by Research Triangle Institute on behalf of NIST
- To be Completed 2001
- Project Team:
  - Dr. Thomas A. Phelps (ERIM)
  - Dr. Gregory Tassey, Dr. Simon Frechette, and Dr. James Fowler (NIST)

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Background

- The Standard for Exchange of Product model data (STEP) is an international standard designed to address interoperability problems encountered in the exchange of digital information.
- STEP is a suite of standards enabling manufacturing companies to exchange digital representations of engineering and manufacturing data.
- The first 12 parts of STEP were formally approved as international standards in January 1995.
- Since then, an additional 18 or so parts have become international standards. Over 20 more are nearing international standard status, with many more in earlier development stages.

Project Objective

- Conduct a microeconomic impact assessment of NIST's administrative and technical contributions to STEP
- Analysis Steps
  - Estimate the current and near future economic impact of STEP
    - Develop a time series of net benefits (benefits – costs)
    - Benefits are the value of the efficiency gains due to enhanced data exchange enabled by using STEP
    - Costs include development (vendors) and adoption (users) costs by industry
  - Determine NIST's Role in the development and adoption of STEP
    - Faster, cheaper, better

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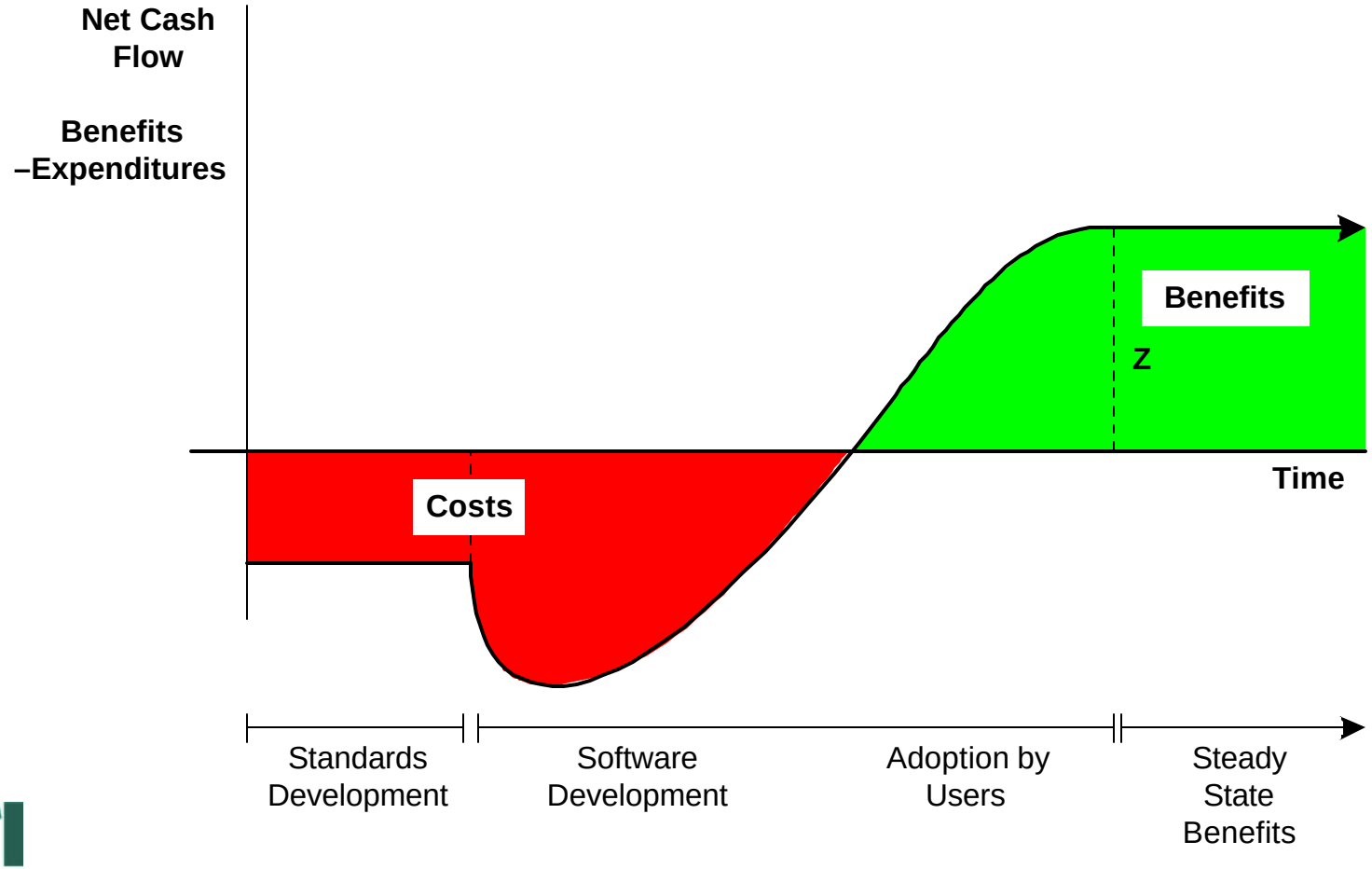
Project Scope

- Focus on the following industry supply chains
  - Automotive
  - Aerospace
  - Shipbuilding
- Focus only on interoperability costs where STEP is currently (or will be the near future) applicable

Approach


Net Cash Flow
Benefits –Expenditures
Benefits
Z
Costs
Time
Standards Development
Software Development
Adoption by Users
Steady State Benefits

NIST's Contributions

	Segments of the Supply Chain who will be asked about NIST's Contributions
Standards Development	
Administrative contributions Express (ISO 10303-11) AP203 (ISO 10303-203) Mapping Table Generator PDM schema	Government and Academic entities, Software developers, and Users
Software Development Tools and Testing Tools	
NIST Express Toolkit STEP Class Library Expresso STEP File Checker STEP Geometry Analyzer	Government and Academic entities, and Software developers
Demonstration and Certification Services	
AutoSTEP testing project Cax and PDM implementor forums STEP certification services	Software developers, and Users

Data Collection Activities

	Data Collection Approach	Sampling	Number of Interviews/Surveys
Software Developers			
CAD/CAM/CAE software	Telephone interview	Census	25-30
PDM software	Telephone interview	Representative sample	10
Users			
OEMs	Onsite interviews	Representative sample	2 - automotive 2 - aerospace 1 - shipbuilding
First-tier suppliers	Onsite interviews	Representative sample	1 - automotive 1 - aerospace 1 - shipbuilding
Subtier suppliers	Onsite interviews	Representative sample	1 - automotive 1 - aerospace
	Telephone/Internet survey	Random sample	100

Wrap-Up

If you have questions about our past study??

or

If you would like to participate in our current study

Please contact:

Michael P. Gallaher
Director Technology Economics and Policy Analysis
Research Triangle Institute
3040 Cornwallis Road
Hobbs Building
Research Triangle Park, NC 27709-2194
phone: (919) 541-5935
fax: (919) 541-6683
email: mpg@rti.org